



Moments of Inertia

Uninhabited Aerial Vehicle (UAV) Dryden Remotely Operated Integrated Drone (DROID)



Presented by Helida C. Haro
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Agenda

- **Personal Background**
- **Research**
 - Importance
 - Measure, Weight, and CG
 - Design
 - Manufacturing
 - Hangar
 - Safety
 - Approvals
 - Test
 - Data Analysis
- **Questions**





Personal Background

- **Science Teacher And Researcher (STAR)**
- **California State University Northridge (CSUN)
Applied Mathematics Master Student**
- **CA Mathematics Council Member**
- **CSUN Mathematics Club Member**
- **National Science Foundation Scholarship Recipient**





Research

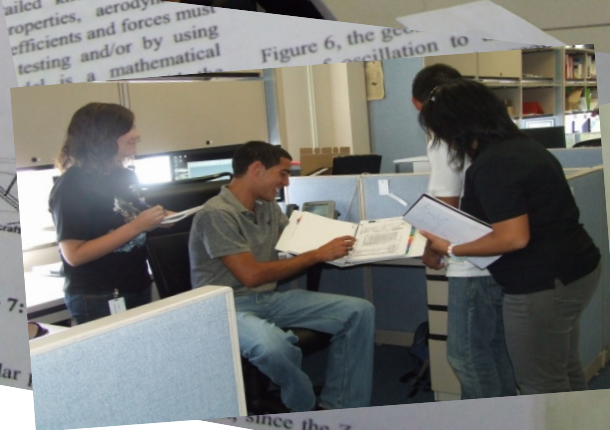


Figure 7, include the lengths of the vertical threads and the distance between the parallel bifilar. The inertia of the mounting





Mass Properties

The mass properties of an object are simply the proportionality constants between applied force and the resulting acceleration:

$$f = m\ddot{x}$$

$$T = j\alpha$$

This is Newton's 2nd law for 1 Degree of Freedom (DOF) translation and rotation, respectively

When expanded to 6 DOF:

$$\begin{matrix} \text{Mass} \\ \text{6 DOF} \\ \text{force} \end{matrix} \begin{bmatrix} F_x \\ F_y \\ F_z \\ M_x \\ M_y \\ M_z \end{bmatrix}_P = \begin{bmatrix} m & 0 & 0 & 0 & 0 & 0 \\ 0 & m & 0 & -mZ_{CG} & mY_{CG} & 0 \\ 0 & 0 & m & mY_{CG} & -mX_{CG} & 0 \\ 0 & -mZ_{CG} & mY_{CG} & I_{xx} & -I_{xy} & -I_{xz} \\ mZ_{CG} & 0 & -mX_{CG} & -I_{yx} & I_{yy} & -I_{yz} \\ -mY_{CG} & mX_{CG} & 0 & -I_{zx} & -I_{zy} & I_{zz} \end{bmatrix} \begin{bmatrix} \ddot{x} \\ \ddot{y} \\ \ddot{z} \\ \ddot{\theta}_x \\ \ddot{\theta}_y \\ \ddot{\theta}_z \end{bmatrix}_P$$

CG information

Inertia Tensor

6 DOF acceleration





Importance

The inertial characteristics have direct consequences on:

Aerodynamics

Propulsion

Structures

Control





Measure, Weight, and CG



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Design



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Shuttle Hangar



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Safety

- **Human Hazard Analysis**
- **Loss of Asset/Mission Hazard Analysis**





Approvals

- **Critical Design Review (CDR)**
- **Tech Brief**





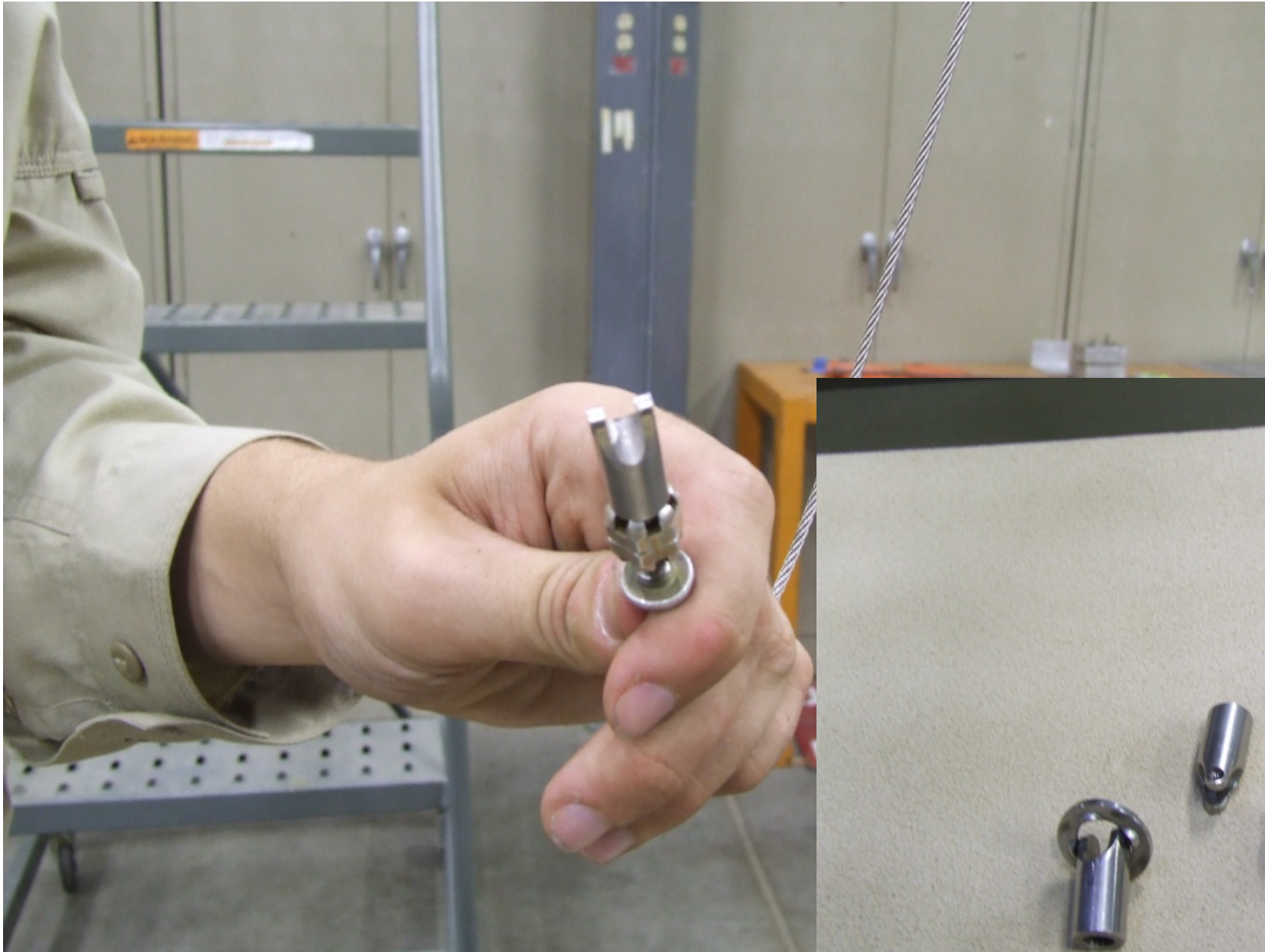
Testing











UAVSAR Longitudinal Center of Gravity
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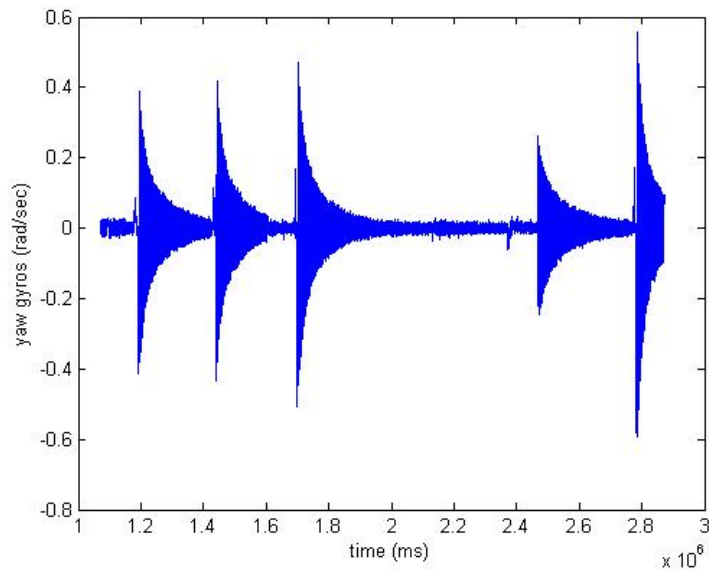








Data Analysis



- Time Constraints
- Basic Geometric Shapes
- MATLAB
- Coupling





Questions?



Mark, Chris, Aaron, Lesli, Stephanie, Alex, and Helida

All photos provided by: NASA photographer, Thomas P. Tschida and INSPIRE Team

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